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ABSTRACT

A questionnaire was administered to 167 preservice elementary education undergraduates. The questionnaire was designed to assess the relatedness of personological variables to the expected use of computers in teaching by preservice student teachers. The data collected comprise the baseline for a 5-year longitudinal study that is to be conducted over four phases. The variables that were hypothesized to predict computer use include age, gender, experience with computers, innovativeness, teacher locus of control, perceived self-competence in computer use, and perceived relevance of computers to teachers. An overwhelming percentage of the preservice teachers seems to expect to use computers for teaching if only at the utilization level. The two variables of "perceived relevance" and "self-competence" emerged as being statistically significantly correlated with and as predictors of computer use. A discussion of plans for the remaining phases of the study concludes this report. (46 references) (Author/BBM)

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Title:

The Relationships of Personological Variables to Computer Use by Elementary School Teachers: Report of Phase One - Baseline Data

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Abstract

A questionnaire was administered to one hundred and sixty-seven preservice elementary education undergraduates. The questionnaire was designed to assess the relatedness of personological variables to the expected use of computers in teaching by preservice student-teachers. The data collected comprise the baseline for a five-year longitudinal study that is to be conducted over four phases.

Discrepancy Identified

With computers becoming increasingly available in schools, it is widely believed that educational technology—especially computer technology—could have a major positive impact on improving the educational system. This view has gained the endorsement of federal researchers (see The National Task Force on Educational Technology, 1986; United States Office of Technology Assessment [OTA], 1988)...academic scholars (Sheingold and Hadley, 1990)...and educational politicians (Albert Shanker, 1990). Perhaps due to the favorable disposition of opinion leaders towards computer technology in education, computers for teaching have become increasingly available. In the period from 1983 to 1987, the average pupil-to-computer ratio in public elementary schools improved from 112.4 to 36.8 pupils per computer (OTA, 1988).

Yet, in spite of these positive trends, computers remain underutilized by teachers. While researchers support the continuing increase in the availability of computers, they note this caveat—that the key to profiting from computers does not lie in their sheer presence; but rather, in the way in which they are used (see Berman & McLaughlin, 1978; NTFET, 1986; Salomon & Gardner, 1986). Unfortunately, a relatively small number of teachers have integrated computers into their teaching. Sheingold and Hadley's survey (1990) has shown even in schools where the availability of computers per school was more than double the national average there was only about one teacher per school who integrated the computer into their teaching.

Disturbingly, there is a strong sentiment among teachers that several promising breakthroughs in educational technology have not realized their widely-held expectations for revamping education (Ely & Plomp, 1988). Note the assertions of the titles to these articles "Computer Integration in Instruction Is Stuck...," (Dronka, 1985), or,..."Computer 'Revolution' [Is] On Hold..." (O'Neill, 1990), or,..."The Revolution That Fizzled" (Bjerklie & Hollis, 1991). Teachers have reported disillusionment with educational technology. Also, some writers suggest that there is little research evidence on the effectiveness of educational technology and that which exists provides little direction for teachers in how to use the technology most appropriately (Becker, 1987; Roblyer, 1988). The opinion of and use of educational computing by teachers does not seem to agree with the views of federal researchers, academic scholars, and educational politicians and their expectations for the use of educational computing.

We hypothesize that there may be several personological variables which influence teachers to use computers in their teaching. We reasoned that if teachers still did not integrate computers into their teaching in professional educational environments where computers were readily or reasonably available, then an examination of selected teachers' internal variables would be informative. Researchers which support the effect of personological variables on behavior include Gagné, 1978; Gilbert, 1975; Keller, 1983; Vroom, 1966. Before discussing the personological variables though, the situation which is established by the condition of availability is considered.

Availability/Exposure/Cognitive Dissonance

The availability of computers to teachers in a school causes a situation that would be termed "forced exposure" in the theory of cognitive dissonance (Festinger, 1962, p. 133). This means that exposure to the computers is inevitable and occurs regardless of a teacher's intentions. The theory predicts that in this situation a person's response would be one of either information seeking or avoidance. This situation is key to this study since an examination of the personological variables related to a teacher's response to computers can only reasonably occur when computers are available in a teacher's work environment. Because the baseline data were collected with preservice undergraduate teachers, their responses could not reflect their actual use of computers for teaching. Rather, the preservice teachers were instructed to respond to the portion of the assessment measuring *use* in terms of what they *expected to be true* in the future regarding their use of computers in teaching. In the later phases of this study when the subjects are professional teachers, the availability of computers in the subjects' schools will be required in order for the subjects' to remain eligible. Presently, availability has been defined as a maximum pupil-computer ratio of 44 to 1 (Marcinkiewicz, 1991).

The availability of equipment is a reasonable prerequisite for the accomplishment of work, but availability itself is insufficient. One line of thought suggests that forced exposure be extended to forced use. In other words, whether or not a teacher were inclined or predisposed to use computers would be subordinated by the requirement of use. A realistic expectation is that teachers' use of computers would be pro forma if it were mandated by their administration (Berman & McLaughlin, 1978, p. 15). What is not clear is the extent to which teachers would use available computers if they were *not* directed to do so. The following section discusses the variables which will be examined in the subsequent phases to determine whether they are predictive of teachers' computer use.

Predictor Variables

The variables that were hypothesized to predict computer use include age, gender, experience with computers, innovativeness, teacher locus of control, perceived self-competence in computer use, and perceived relevance of computers to teaching. The first three demographic variables are exogenous—they are influential but are not subject to intervention. The latter four are endogenous—they are influential and are subject to intervention. The selection of this set of variables is substantiated by well founded theories and by empirical evidence which relates them to computer use. Knowledge of the predictive relationship of any of these variables to computer use would be informative for intervention with teachers or for differential staffing.

Computer Use

Computer *use* was operationally defined as the integrated employment of computers in the classroom. This dimension was derived from a model of Instructional Transformation described by Rieber and Welliver (1989) and Welliver (1990) in which a teacher progresses through levels of involvement with computers. At the first level, a teacher becomes familiar with computers (*familiarization*); then, begins to use computers in teaching (*utilization*). A higher level of use is observed when the teacher's computer use becomes critical to his or her teaching (*integration*). At this level, teachers consciously and inextricably dele gate some of their duties to the computer and are aware of the changes to their role as a result. It is at this level too that the teacher is aware of the changes to the teacher's role as a result of the integration of computers. For a teacher, this new awareness of the restructuring of instructional activities leads to a pursuit of fine tuning the computer-teacher-student relationship (*reorientation*). The final level (*evolution*) is more of a suggestion than a level—to continue practicing and learning about how to improve instruction through

the systematic implementation of computer technology. Key to this level is that the teacher remain sensitive to, be prepared for, and be able to adapt to change. An analogy to this adoption of computer use would be that if upon learning to drive (familiarization), one uses a car to improve one's general transportation in order to fulfill a variety of purposes (utilization). One may then schedule the use of the car so that the vehicle is critical to the fulfilling of the purposes (integration). At the same time, one becomes aware that the new technology has significantly altered aspects of one's role. Computer *use*, therefore, was assessed with the Levels of Use (LU) assessment (Marcinkiewicz, 1991) which had been developed based on the model of Instructional Transformation.

Age

The relationship of age to computer use is as yet, unclear. Respondents to Sheingold and Hadley's survey (1990) of outstanding teacher-users of computers comprised a group, over half of whom were between 40 and 49. In research on innovation (Rogers & Shoemaker, 1971), the effect of age has shown mixed results. Rogers (1983) reports that the more mature favor change.

Gender

The differences in computer use between males and females suggests that there may not be equality in their education. Gilliland (1990) discusses differences in gender-attributable perceptions. For example, females were more negative in their attitudes towards computers and expressed lower expectations of computer use and computer usefulness than did males.

Sheingold and Hadley (1990) showed an equal distribution of computer users between male and female teachers. Jorde–Bloom and Ford's (1988) findings on gender were unclear because of the low number of males, although being male correlated more highly with several variables than did being female. Rogers (1983) indicates that females typically showed lower levels of acceptance of innovative behavior than males. Gender differences were reported to correlate significantly with attitudes towards computer use (Dambrot, Watkins–Malek, Silling, Marshall & Garver, 1985). Males held more positive attitudes towards computers a. scored higher in computer aptitude. Goldman, Kaplan, and Platt (1973) found that "mechanical curiosity" was consistent for both males and females in choosing college majors but that females "needed" less of this attitude than men even if they were successful science majors. Marcinkiewicz (1991) reports that gender did not predict levels of computer use for elementary school teachers.

Experience with Computers

The amount of experience an individual has in a specified behavior contributes directly to the individual's general tendency of expectations about that behavior (Rotter, 1954). Rogers' (1962) description of the adoption process describes an individual's mental interaction, or the organization and elaboration of thoughts and attitudes, with experience. In the adoption process, progression from awareness, interest, evaluation, trial, and finally, adoption is influenced by experience. Experience is also elemental to Rieber and Welliver's (1989) description of the *familiarization* level of the model of Instructional Transformation. At that level familiarity with computers develops through a teacher's experience with them.

Computer attitude has also been related to computer experience (Dambrot et al, 1985). Jorde–Bloom and Ford (1988) found that experience with and knowledge of computers and experience with educational innovations were among the factors with the strongest positive relationship to computer use by early childhood education administrators. For Sheingold and Hadley's survey (1990), 73% of the respondents used computers in their teaching for five years or more. Marcinkiewicz (1991) reports

that computer experience did not predict levels of computer use elementary school teachers.

Innovativeness

Rogers and Shoemaker (1971) define innovativeness as the degree to which an individual is relatively earlier in adopting innovations with respect to others in a social system. Innovativeness is a stable personality measure in relation to the diffusion of innovation.

In their development of the Innovativeness Scale, Hurt, Joseph, and Cook (1977) have focused on the measurement of an individual's "willingness to change." This is the focus for this study. An individual's predisposition for change is measured by using self-report measurements. Marcinkiewicz (1991) reports that innovativeness did predict levels of computer use by elementary school teachers.

Expectancy Theory: Valence, Expectancy, Instrumentality

Three variables were selected to represent the components of expectancy theory. In the scheme of expectancy theory of behavior, there are three components of perception: 1) *valence*, which refers to some goal one values or desires; 2) *expectancy*, which refers to the expectation that by one's effort one is capable of achieving some performance; and 3) *instrumentality*, which refers to the belief that the achieved performance actually results in acquiring the valued goal (Vroom, 1964). For example, expectancy theory would predict that one would be motivated to use a computer for teaching if one believed that expending a modest amount of effort would result in competent use of the computer (expectancy), and using the computer would be instrumental in achieving a valued goal (instrumentality) such as better instruction/learning. The goal of improved instruction is valued by the teacher (valence). Valence of improved learning was assumed to be uniformly true for this sample. Expectancy and instrumentality were measured. Expectancy was assessed by teacher locus of control and the reported subjective probability of one's capability to use computers competently. In this study, computer expectancy referred to the degree to which one felt capable of achieving competence in using the computer in teaching. Instrumentality was gauged by assessing one's "perceived relevance of computers to teaching." In this study, this referred to the degree to which one perceived computer use as being instrumental in or key to achieving the valued goal of better learning by students (For the remainder of this discussion this variable will be referred to as *perceived relevance*.)

Locus of control is working in tandem with "self-efficacy" theory in accounting for the expectancy component of the above theoretical framework. Locus of control refers to a person's belief that the outcomes of a behavior are dependent on one's own actions, fate, or luck. Self-efficacy refers to a person's belief as to whether or not he or she is capable of a certain performance. Studies of locus of control have supported prediction of a person's future behavior and a person's initiative in controlling his or her environment (Rotter, 1966). Studies of self-efficacy have predicted performance not predicted by locus of control such as academic performance, tendency towards anxiety, etc. (Manning & Wright, 1983; Taylor & Popma, 1990). The comprehensiveness and independence of the two constructs as measures of expectancy is strongly debated (Bandura, 1982, 1989). It is not suggested that the measure included in the questionnaire has captured the complexity of the construct of self-efficacy; "the subjective probability of using computers competently in teaching" variable may be related to self-efficacy and only nominally measure expectancy. However, by including this measure, a different aspect of expectancy can be assessed apart from that assessed by locus of control. (For the remainder of this discussion this variable will be referred to as *self-competence*.). Gallo's investigation (1986) predicted individuals intentions to use computer technology using a formula for expectancy theory. Marcinkiewicz (1991) reported that "the subjective probability of using computers competently in teaching"—a concept related to self-efficacy—did predict elementary school teachers' levels of computer use. Indeed, in Marcinkiewicz'

study, teacher locus of control was also measured but was not identified as a predictor of computer use. It was however, correlated with the self-competence variable.

Measures Selected: the Component Assessments

The dependent variable in this study was three categories of computer use: 1) Nonuse; 2) Utilization; and 3) Integration.

The independent variables were 1) age, 2) gender; 3) experience with computers; 4) perceived relevance of computers to teaching; 5) the subjective probability of the competent use of computers in teaching; 6) teacher locus of control; and 7) innovativeness.

The questionnaire used in this study comprised several component assessments (See Table 1). They were 1) the Levels of Use (LU) assessment; 2) the Innovativeness Scale (IS); 3) the assessment of perceived relevance of computers to teaching; 4) the assessment of subjective probability of capability to use computers competently in teaching (self-competence); 5) the Teacher Locus of Control scale (TLC) and 6) the Teacher Role Survey (TRS). Data for three demographic variables: age, gender, and years of computer experience were also collected. Also, an item for self-rating one's use of computers was included to estimate criterion-related reliability of the LU assessment.

Use of computers was assessed with the LU assessment (Marcinkiewicz, 1991) in which paired comparisons were used. This technique was appropriate because cut-off levels of computer use were defined which were mutually exclusive and exhaustive. This method is considered the "...most exact psychophysical tool..." useful for precise information concerning judgments or preferences (Nunnally, 1959, p. 20–21). The levels of utilization and integration are represented by two items each. One item from the utilization level is paired with an item from the integration level. The response procedure is forced choice; therefore, the subject is directed to select the statement which he or she most strongly feels is true about him or herself. Because the subject was asked to respond to each of the items twice, any inconsistency in responding was readily evident.

Validity of the Levels of Use Assessment (LU)

One control item was included on the questionnaire which was not computed in the data analysis. Respondents were to select from three descriptions, the one which best matched their expectation about their teaching in a given situation. This item was written to reflect the same dimension of use as in the LU but from a different perspective. Its function was to provide an additional measure about the teachers' self-report of use from which criterion-related validity could be established. A measure of association between it and the LU was computed. Subjects' responses to this item were matched with their levels of use. Cohen's kappa (Crocker & Algina, 1986, p. 198–202; Suen, p. 165–167) was computed to estimate the consistency of classification of the measures (kappa = .72).

Reliability of the Levels of Use Assessment (LU)

Reliability was estimated using the Coefficient of Reproducibility (*CR*) which also demonstrated that the items of the LU formed an ordered scale. The *CR* for the LU component of the questionnaire was *CR* = .96 (Marcinkiewicz, 1991). A *CR* of .90 is considered the criterion for demonstrating that the items form an ordered scale of allowable response patterns (Bailey, 1987, 348; Crocker & Algina, 1986, p. 56).

Table 1
The Variables and Their Related Instruments

	Dependent variables	Instrument	Reliability	Validation
1.	expected levels of computer use for teaching	Levels of Use (LU) assessment	Coefficient of Reproducibility *CR* = .96 (*n* = 170) kappa = .72	content, face, criterion-related—correlation of self-rating item with the LU
	Independent variables			
2.	innovativeness	Innovativeness Scale (IS)	*r* = .89	construct, predictive
3.	perceived relevance	one item	N/A	content
4.	self-competence	one item	N/A	content
5	locus of control	Teacher Locus of Control Scale (TLC)	*KR 20*= .81 for I- subscale and .71 for the I+ subscale. Item total *r* were significant ($p<.01$)	criterion-related, predictive
6	locus of control	Teacher Role Survey (TRS)		criterion-related, predictive
	Demographic variables			
7.	age	number years	N/A	N/A
8.	gender	male or female	N/A	N/A
9.	computer experience	number of years	N/A	N/A

The Innovativeness Scale (IS)

Hurt, Joseph, and Cook's (1977) Innovativeness Scale (IS) was developed to capture a particular aspect of innovation, the "willingness to change." This aspect of innovation was appropriate for this study since it identifies a predisposition—a personological variable. The IS is an instrument requiring self-report scored on a 7-point scale. Responses are scored as 7 = strongly agree; 6 = agree; 5 = moderately agree; 4 = undecided; 3 = moderately disagree; 2 = disagree; 1 = strongly disagree. The scoring has been designed so that a higher score indicates a higher degree of innovativeness. There are two forms of the IS—the original 20-item form and a shortened 10-item form. The shortened form was used to expedite the completion of

the questionnaire. Its use was supported by the strength of its relationship to the original (r = .92).

Validity of the IS

The authors (Hurt, Joseph, and Cook, 1977) claim of construct validity is based on the correlated distribution of responses of their study with the distribution of innovator types identified by Rogers and Shoemaker (1971) on the basis of actual adoption. Secondly, innovativeness is characterized as being unidimensional. The factor analyses conducted by Hurt, Joseph, and Cook revealed that the factor structure of the IS was unidimensional.

Evidence has been reported supporting the predictive validity of the IS. Witteman (1976) hypothesized that high levels of innovativeness would be related to high levels of opinion leadership. Witteman also hypothesized that innovativeness would be negatively related with communication apprehension. There was a significant linear correlation of .50 between the responses to the IS and the measure of opinion leadership (n = 936). There was a significant linear correlation of -.45 between responses to the IS and the measure of communication apprehension.

Reliability of the IS

Reliability for the 20-item form of the instrument was estimated using a *KR - 20* for making all possible split-half comparisons (Hurt, Joseph, & Cook, 1977). This analysis resulted in an estimated reliability coefficient of *KR-20* =.94. Furthermore, all of the 20 items "discriminated significantly" (1977) between the upper and lower 27% of the distribution. The shortened form was made up of 10 of the original 20 items which had the highest item-total correlations. The 10-item shortened form has an "...internal reliability of r = .89,..." and its correlation with the 20-item scale is r = .92.

The Perceived Relevance of Computers

Subjects rated their agreement with an item stating that computers were relevant to teaching. They rated their perceptions on a 7-point scale. Responses were scored as 7 = strongly agree; 6 = agree; 5 = moderately agree; 4 = undecided; 3 = moderately disagree; 2 = disagree; 1 = strongly disagree.

The Subjective Probability of Competence

Subjects rated their agreement with an item stating that they perceived themselves as capable of using the computer competently in teaching. They rated their expectations on a 7-point scale from strongly agree to strongly disagree (1).

Teacher-Related Locus of Control Scales

A principle question in this study was to determine whether a teacher's locus of control is related to his or her level of computer use . The Teacher Locus of Control (TLC) Scale by Rose and Medway and the Teacher Role Survey (TRS) scale were selected because they were designed to measure the construct for teachers.

Teacher Locus of Control Scale

The TLC was appropriate because it measured teachers' beliefs in their control over student outcome. This is the same construct expressed in the Rand report for the U. S. Department of Health, Education, and Welfare (Berman, & McLaughlin, 1978) as being the most instrumental in predicting implementation of innovation for teacher attributes. The TRS was appropriate because it focuses on teachers control over their situation as professionals.

The TLC scale comprises 28 forced-choice items where respondents must endorse an alternative identifying either external or internal control of classroom events. Fourteen of the items describe positive or success situations and 14 describe situations which are negative or failure situations. Each item has two stems representing the alternate loci of control. Separate scores emerge for each subscale: the belief in internal responsibility for student success (I+) and student failure (I-). Scoring is 1 point for the internal response only. The range of scores possible is from 0 to 28. Since the partitioning of values by the subscales was not relevant to this study, the total of all internal responses was used for a respondent's locus score.

Validity of the TLC.

Rose and Medway (1981) report two validity studies. In the first study of criterion-related validity, the TLC and Rotter's (1966) original locus of control scale, the I-E scale, were administered simultaneously to teachers undergoing training in innovative educational practices. After the training, the teachers were rated for their implementation of those practices by independent raters. Correlations for the TLC scores and the I-E scores with the independent ratings of teachers' implementation of innovative educational practices revealed that the TLC was related to the independent ratings whereas the I-E was not. The correlations are reported in Table 2. The I+ refers to the subscale measuring internality in the context of student success situations. The I- refers to the subscale measuring internality in the context of student failure situations.

Table 2

Correlation (*r*) Values for the TLC Subscales and Rotter's I–E Scale with Independent Ratings of Teachers' Implementation of Innovations

I+ (success)	I- (failure)	Rotter's I-E
.50*	.46*	.28
.46*	.36	.19
.34*	.40*	-.07
.48*	.42*	.09
.48*	.44*	.01
.55**	.62***	-.09
.37	.63***	-.18

(*$p < .05$; **$p < .01$; ***$p < .001$)

In the second study (Rose and Medway, 1981), the predictive validity of teachers' locus of control to teachers' classroom behavior types was examined. Both the TLC and the I-E scales were administered to teachers. For six types of behavior studied, the I-E resulted in only one significant correlation while there were five for the TLC.

Reliability of the TLC

Internal consistency was calculated from the results of the final trial of four pilot studies comprising 89 elementary teachers. All item-to-total score correlations were significant ($p < .01$). Kuder-Richardson formula 20 reliabilities were .81 for the I- subscale and .71 for the I+ subscale.

Teacher Role Survey (TRS)

The TRS scale (Maes & Anderson, 1985) includes 24 forced-choice items for which teachers report their perceived power in their role as teachers. Each item has two stems representing the alternate loci of control. By design, scoring is 1 point for the external response only. However, the scoring was reversed in this study; the internal scores were totaled so that the value for TRS locus of control would be consistent with the TLC value of locus of control. The range of scores possible is from 0 to 24.

Validity of the TRS

Anderson and Maes (1986) report criterion-related validity for the TRS which is supported by 1) a significant positive correlation ($r = .31; p < .01$) between the TRS and the Rotter I-E scale (Rotter, 1966); 2) a significant negative correlation—as predicted—($r = -.27; p < .01$) between the TRS and the Responsibility for Student Achievement (RSA) Total (Guskey, 1981); and 3) a significant positive correlation between the TRS and four symptoms on the Symptom Questionnaire (Kellner & Sheffield, 1973): anxiety—$r = .31, p < .005$; depression—$r = .35, p < .001$; hostility—$r = .28, p < .01$; and Total Symptoms—$r = .34, p < .001$.

Reliability of the TRS

Maes and Anderson report alpha reliability estimates of .87 (1985) and .85 for the original 32-item version of the TRS. A two-week interval test-retest reliability was estimated at .75.(1986). The estimated alpha reliability reported for the revised 24-item TRS, as was used in this study, was .84 (1986).

Sample

The sample comprised 167 undergraduate students who were in the penultimate year of their preservice training. The group was randomly divided in half with the only distinction being that each group used a different form of locus of control measure. Two locus of control measures were used because it was felt that locus of control ought to be predictive of teachers' computer use and while these two measures overlapped they were distinct in the situations they addressed. Because of the time required to administer both, it was decided to only administer one to each half.

The undergraduates elementary education majors were selected since as future elementary school teachers, they should be teaching a variety of subjects and not be influenced to use computers by subject matter which naturally use computers. For example, secondary school teachers typically are subject matter specialists. Some subject areas such as mathematics or language arts may emphasize the use of computers; the teachers' use of computers in teaching may be largely influenced by the prevalence of the computers use in the subject area.

Results

Table 3 shows the distribution of the preservice sample by expected levels of computer use. Preservice undergraduate teachers were instructed to respond to the assessment items according to their *expected* level of computer use.

Table 3
Classification of Preservice Teachers by Levels of Expected Computer Use

Computer Use Levels	Preservice Teachers	%
Nonuse	4	2.7
Utilization	126	84
Integration	20	13.3
Total	150	100

Note. 17 cases were deleted due to missing values or because responses to the LU assessment were inconsistent.

Use: Of the 167 subjects participating, 17 were not eligible for classification of use according to the LU assessment—these were considered missing values. Of the 150 subjects classified for use, there were 4 who did not expect to use computers at all for teaching. The majority—84%—were classified at the Utilization level, and 13% were classified at the Integration level. The question raised is what their levels of use will be at the subsequent phases of their careers. For a comparison with the levels of use of practicing teachers see Marcinkiewicz (1991); it was found that the levels of use were inconsistent with the expected levels of use of the preservice teachers.

The descriptive data reported in Table 4 includes the mean, standard deviation, minimum and maximum values for each variable as well as the mode, percentage and the count of the mode.

Descriptive Statistics

Table 4
Descriptive Summary

variable	min	max	mean	*s.d.*	mode	%	count out of 167
age	20	41	22.7	4.2	20–23	85	142
gender					female	92	154
experience	0	13	2.9	2.1	2–4	38.9	65
innovativeness	34	70	53.9	7.4	50–55	28.1	47
locus of control	26	71	50	10	45–52	26.3	44
perceived relevance	1	7	6.05	1.1	6–7	79	132
self-competence	1	7	5	1.5	6	35.3	59

Note. Mean values were substituted for any missing values so that correlations were computed for all respondents including those whose responses to the LU assessment were inconsistent.

Four of the predictor variables, are age, gender, perceived relevance, and self-competence are relatively uniform—they have little variation. This was anticipated for this sample regarding age and gender. Eighty-five percent of the sample was between the ages of 20 to 23 and 92% was female. Future observations will bear little information regarding the influence of gender. However, any change in computer use for the group as a result of chronological aging might be quite informative.

It is noteworthy that the sample rather uniformly tended towards a perception of high relevance of computers to teaching (perceived relevance) and a perception of

high likelihood of the ability to use computers competently for teaching (self-competence).

The mean of years of computer experience was 2.9 (*s.d.* = 2.12) with a range of 0 to 13. The mean score for innovativeness was 53.93 (*s.d.* = 7.4) with a range of 34 to 70. The two teacher locus of control measures (TRS and TLC) were standardized to T-scores. This was done because the entire sample used identical questionnaires except that half were randomly administered questionnaires which included the TRS and the other half were randomly administered the TLC.

Correlations were computed for both halves as well as logistic regressions to determine if either locus of control measure was related to use. The correlation of the TLC to use was $r = .16$; $p = .14$. The correlation of the TRS to use was $r = .09$; $p = .37$. In a stepwise logistic regression, neither measure of teacher locus of control was identified as a predictor for its respective half of the sample. Since the measures of locus of control were neither significantly correlated to use nor were they identified as predictors of use and because they had differing scales, the teacher locus of control values were standardized to T-scores and the reported correlations and logistic regression were computed for the entire sample. The T-score mean was 50 and the *s.d.* was 10.

Intercorrelation of all variables were computed. (See Table 5). The two variables that resulted in moderate and statistically significant correlations to use were perceived relevance and self-competence—$r = .28$; $p < .01$ and $r = .23$ $p < .05$ respectively. These two variables are complements derived from expectancy theory.

Table 5
Intercorrelations of All Variables in the Analysis

	use	age	gender	comput. exp.	innovat.	locus of control	perceiv'd relev'nce	self-comp.
use	—							
age	-.098	—						
gender	.121	.042	—					
computer experience	.094	-.087	.208	—				
innovativeness	-.011	.08	-.119	-.033	—			
locus of control	.125	.047	-.081	.091	.242 *	—		
perceived relevance	.28 **	.034	.081	.319 **	.059	.073	—	
self-competence	.23 *	.138	.106	.264 *	.07	.022	.376 ***	—

*$p < .05$; **$p < .01$; ***$p < .001$

Other statistically significant correlations were years of computer experience with perceived relevance ($r = .319$; $p < .01$); and years of computer experience with self-competence ($r = .264$; $p < .05$). Innovativeness was correlated to the standardized locus of control values which assessed for internal locus of control ($r = .242$; $p < .05$).

The correlation between perceived relevance and self-competence was strongest ($r = .376$; $p < .001$). This relationship may support the theorized complementary nature of these two variables. ($n = 167$ for all variables except use, average values were included for one case missing in each of age, gender, locus of control, and innovativeness)

A logistic regression was computed to explore the possible predictiveness of these variables to *use*. The two variables identified as predictive were perceived relevance and self-competence.($R = .27$; $p < .05$ and $R = .22$; $p < .05$).

Future Plans

Because perceived relevance and self-competence were computed to be most highly correlated with computer use and because their complementary nature is supported by expectancy theory, a more precise investigation of them and their relationship to computer use will be undertaken in the upcoming phases of this study. A measure of self-efficacy in computer use has been identified. A measure of perceived relevance is being developed.

Teacher locus of control may not be assessed in the future phases for two reasons. First, none of the teacher locus of control scales—the TLC or the TRS—either individually or as combined values standardized in T-scores were strongly or significantly correlated to *use*. Secondly, locus of control together with stability is a dimension of the construct of self-efficacy. The construct underlying the measure of self-competence is related to the construct of self-efficacy. Therefore, it is anticipated that assessment of self-efficacy will encompass locus of control as well.

We plan to control for the influence of environmental factors. In the future phases of the study when the subjects will actually be professional teachers, some effects of the environment will be controlled by limiting the subjects' eligibility for participation in the study by specifying maximum pupil-computer availability ratios at their respective schools. The planned for maximum pupil-computer availability ratio is 44–1 following the precedent of Marcinkiewicz (1991). That had been based on national averages from 1987 (OTA). However, given the increased availability of computers in education, the availability ratio may be halved; so that, in order for a teacher to participate in the study, the teacher will have to work in a school where there is at least one computer available for no more than 22 children. There is however, an aspect of the environment that has not been included in this study but which has been proposed in the theory of planned behavior (Ajzen, 1985). That is, the element of *subjective norms* which, briefly, means one's perception of the expectations of one's environment. Including this variable may be informative and it will complement the variables currently assessed.

Conclusion

An overwhelming percentage of preservice teachers seems to expect to use computers for teaching if at least at the utilization level. The two variables of "perceived relevance" and "self-competence" emerged as being statistically significantly correlated with and as predictors of computer use . This result is congruent with expectancy theory of which these variables are components. The results have encouraged us in our examination of these variables in relation to computer use by teachers.

REFERENCES

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl and J. Beckman (Eds), Action-control: From cognition to behavior, (pp. 11–39). Heidelberg: Springer.

Bandura, A. (1982). Self-efficacy mechanism in human agency. American Psychologist, 37, 122–147.

Bandura, A. (1989). Human agency in social cognitive theory. American Psychologist, 44, 1175–1184.

Becker, H. J. (1987). The impact of computer use in children's learning: What researchhas shown and what it has not (Report No. 18) Baltimore, MD: The Johns Hopkins University, Center for Research on Elementary and Middle Schools.

Berman, P. & McLaughlin, M. W., (1977) Federal programs supporting educational change, Vol. II:Factors affecting implementation and continuation. Santa Monica, CA: The Rand Corporation.

Bjerklie, D. & Hollis, R. W. (1991, May 20). The revolution that fizzled. Time. pp. 48–49.

Coovert, M. D., & Goldstein, M. (1980). Locus of control of users' attitude toward computers, Psychological Reports. 47, 1167–1173.

Crocker, L. & Algina, J. (1986). Introduction to classical and modern test theory. New York: Holt, Rinehart, and Winston.

Dambrot, F. H., Watkins-Malek, M. A., Silling, S. M., Marshall, R. S., & Garver, J. A. (1985). Correlates of sex differences in attitudes toward and involvement with computers. Journal of Vocational Behavior, 27, 71–86.

Dronka, P. (1985). Computer integration into instruction is stuck: Experts blame unclear optimal uses and three implementation problems. ASCD Update. 27(5), 1–8.

Ely, D. P., & Plomp, T. (1988). The promises of educational technology. In B. Branyan-Broadbent & R. K. Wood (Eds.), Educational media and technology yearbook 1988, 5–18. Englewood, CO: Libraries Unlimited.

Festinger, L. (1962). A theory of cognitive dissonance (2nd reissue). Stanford, CA: Stanford University Press.

Gagné, R. M. (1985). The conditions of learning and theory of instruction (4th ed.). New York: Holt, Rinehart, & Winston.

Gallo, D. D. (1986). Expectancy theory as a predictor of individual response to computer technology. Computers in Human Behavior, 2, pp. 31–41.

Gilbert, T. F. (1978). Human competence: Engineering worthy performance. New York: McGraw Hill.

Goldman, R. D., Kaplan, R. M. & Platt, B. B. (1973). Sex differences in the relationship of attitudes toward technology to choice of field of study. Journal of Counseling Psychology, 20, 412–418.

Guskey, T. R. (1981). Measurement of the responsibility teachers assume for academic successes and failures in the classroom. Journal of Teacher Education, 32, 44–51.

Hurt, H. T., Joseph, K., & Cook, C. D. (1977). Scales for the measurement of innovativeness. Human Communication Research, 4, 58–65.

Jorde-Bloom, P. & Ford, M. (1988). Factors influencing early childhood a dministrators' decisions regarding the adoption of computer technology. Journal of Computing Research, 4(1), 31–47.

Keller, J. M. (1983). Motivational design of instruction. In C. M. Reigeluth (Ed.), Instructional-design theories and models: An overview of their current status. Hillsdale, NJ: Lawrence Erlbaum.

Kellner, R. & Sheffield, B. F., (1973). A self-rating scale of distress. Psychological Medicine, 3, 88–100.

Maes, W. R. & Anderson, D. E. (1985). A measure of teacher locus of control. Journal of Educational Research, 79(1), 27–32.

Manning, M. M. & Wright, T. L. (1983). Self-efficacy expectancies, outcome expectancies, and the persistence of pain control in childbirth. Journal of Personality and Social Psychology, 45, 421–431.

Marcinkiewicz, H. R. (1991). The relationships of selected personological variables to the use of available microcomputers by elementary school teachers. Doctoral dissertation, The Pennsylvania State University.

National Task Force on Educational Technology. (1986). Transforming American education: Reducing the risk to the nation, a report to the Secretary of Education, United States Department of Education. T.H.E. Journal, 14(1), 58–67.

Nunnally, J. C. (1959). Tests and measurements: Assessment and prediction. New York: McGraw-Hill.

O'Neill, J. (1990). Computer 'Revolution' on hold: Despite scattered progress, few signs of broad-based changes seen. ASCD Update. 32(9), 1–5.

Phares, E. J. (1976). Locus of control in personality. Morristown, NJ: General Learning Press.

Rieber, L. P. & Welliver, P. W. (1989) Infusing educational technology into mainstream educational computing. International Journal of Instructional Media, 16 (1), 21–32.

Roblyer, M. D. (1988). The effectiveness of microcomputers in education: A review of the research for 1980–1987. T. H. E. Journal, 16(2), 85–89.

Rogers, E. M. (1962). Diffusion of innovations. New York: The Free Press of Glencoe.

Rogers, E. M. (1983). Diffusion of innovations (3rd ed.). New York: The Free Press of Glencoe.

Rogers, E. M. & Shoemaker, F. F. (1971). Communication of innovations: A cross-cultural approach. New York: The Free Press.

Rose, J. S. & Medway, F. J. (1981). Measurement of teachers' beliefs in their control over student outcome. Journal of Educational Research, 74(3), 185–190.

Rose, J. S. & Medway, F. J. (1982). Measurement of teachers' beliefs in their control over student outcome [Erratum]. Journal of Educational Research, 75(3), 188–189.

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, 80 (1, Whole No. 609).

Rotter, J. B. (1975). Some problems and misconceptions related to the construct of internal versus external control of reinforcement. Journal of Consulting and Clinical Psychology, 43, 56–67.

Shanker, A. (1990, September 23). Equipping teachers for productivity: From chalkboards to computers. The New York Times, (Section E), p. 7.

Sheingold, K. & Hadley, M. (1990). Accomplished teachers: integrating computers into classroom practice. New York: Bank Street College, Center for Technology in Education.

Solomon, G. & Gardner, H. (1986). The computer as educator: Lessons from television research. Educational Researcher, 15(1) 13–19.

Suen, H. K. (1990). Principles of test theories. Hillsdale, NJ: Erlbaum.

Taylor, K. M. & Popma, J. (1990). An examination of the relationships among career decision-making self-efficacy, career salience, locus of control and vocational indecision. Journal of Vocational Behavior, 37, 17–31.

U. S. Congress, Office of Technology Assessment, Power on! New tools for teaching and learning, OTA-SET-379, Washington, DC: U.S. Government Printing Office, September, 1988.

Vroom, V. H. (1964). Work and motivation. New York: Wiley and Sons.

Welliver, P. (1990). Instructional transformation: A model for change. (The Pennsylvania State University Regional Computer Resource Center report to the

other state centers and member teachers). State College, PA: Regional Computer Resource Center at the Pennsylvania State University,

Witteman, H. (1976). The relationship of communication apprehension to opinion leadership and innovativeness. Unpublished master's thesis. Department of Speech Communication, West Virginia University, Morgantown.